	STATUS	TECHNOLOGY DESCRIPTION	DEMONSTRATION CAPACITY	COAL TYPE	SO2 EFF.%	NOx EFF.%	PARTICULATES EFF.%	HAPs EFF.%	BOILER EFF.% CHANGE	NET HEAT RATE EFF.% (note 21)	USABLE BYPRODUCTS	AVAILABILITY	TURN-DOWN	DEMO BUDGET	PROJECTED CAPITAL (YEAR)	PROJECTED LEVELIZED $
ENVIRONMENTAL CONTROL DEVICES/SO2																
10-Mwe Demo of Gas Suspension Absorption	complete	flue gas desulfurization	10-MWe slipstream	2.61-3.5% S	90+%		99.9+%	HCl=98%; HF=96%; Trace Metals=99%			lo-grade cement	high		$7,717,189	$149/kW (1990) note1	10.35mills/kWh note 1
Confined Zone Dispersion FGD	complete	flue gas desulfurization	73.5-MWe	1.2-2.5% S	50+%									$10,411,600	<$30/kW (note2)	$300/ton SO2 note 2
LIFAC Sorbent Injection Desulfurization	complete	sulfur capture in a vertical reactor	60 MWe	2-2.8% S	70-85%									$21,393,772	$66/kW (note3)	$65/ton SO2 note 4
Advanced FGD	complete	advanced flue gas desulfurization	528 MWe	2-4.5% S	95+%			Chlorides=high; Trace Metals=high			gypsum	99.5%		$151,707,898	$101/kW (1995) note 5	7.2mills/kWh, $223/ton SO2 note5
Innovative Applications of Technology for CT-121 FGD	complete	advanced flue gas desulfurization	100MWe	avg. 2.4% S	90+%		97.7-99.3%	HCl and HF=95%; Most Trace Metals = 80-98%			gypsum	95-97%		$43,074,996		
ENVIRONMENTAL CONTROL DEVICES/NOx																
Micronized Coal Reburning	complete	micronized coal pulverization	148 MWe T-fired; 50 MWe Cyclone	lo-S at Kodak 2.8% S at Milliken		50-60%							8:1	$9,096,486		
Coal Reburning for Cyclone Boiler NOx Control	complete	micronized coal reburning	100 MWe	0.55-1.24% N		52-55%		comparable	-1.5% max				66%	$13,646,609	$43/kW (1990) note 6	1.5mills/kWh; $263/ton SO2 note6
Full-scale Low-NOx Cell Burner Retrofit	complete	lo-NOx cell burners (LNCB)	605 MWe	medium S		53-55.5%	comparable	CO=28-55ppm	+0.16% avg.					$11,233,392	$9/kW (1994)	0.284mills/kWh; $96.48/ton NOx
Gas Reburning and Low-NOx Burners on Wall-Fired Boiler	complete	GR/LNB	158 MWe net	0.4% S	reduced	65% avg.	reduced	CO2=reduced; CO=acceptable	-1.0% approx.					$17,807,258	$26.01/kW (1996) note 7	
SCR Technology for Control of NOx from High-Sulfur Coal	complete	selective catalytic reduction	8.7 MWe equiv.	2.7% S		80+%								$23,299,729	$57/kW (1996) note 8	2.79 mills/kWh; $2036/ton NOx note 8
180 MWe Advanced T-Fired Combustion for Reduction of NOx	complete	lo-NOx concentric firing system; advanced overfire air	180 MWe	high reactivity		45%		no clear effect	-0.3% max	~10,000 Btu/kWh				$9,153,383	$15-$25/kW (1993)	$400/ton NOx
Advanced Combustion Techniques for Wall-Fired Boiler	design	lo-NOx burners w/advanced overfir air & GNOCIS software	500 MWe	1.7% S		68%		no significant diff.	+0.6%					$15,853,900	$19.3/kW	$86/ton NOx
ENVIRONMENTAL CONTROL DEVICES/COMBINED SO2/NOx																
NOXSO SO2/NOx Removal Flue Gas Cleanup	on hold	dry, regenerable flue gas cleanup		med.-hi S	98% (projected)	75% (projected)					S, H2SO4, or liq.SO2			$82,812,120		
SNOX Flue Gas Cleaning	complete	catalytic, advanced flue gas cleanup	35 MWe equivalent	3.4% S	95+%	94%	99+%	high			conc. H2SO4			$31,438,408	$305/kW note 9	6.1 mills/kWh; $219/ton SO2 note 9
LIMB Extension and Coolside Demo — LIMB:	complete	limestone injection multistage burner; DRB-XCL lo-NOx burners	105 MWe	1.6-3.8%	60%	40-50%	high					95%		$19,404,940	$40/kW (1992) note 10	$392/ton SO2 (15 years) note 10
COOLSIDE:	"	duct injection of lime sorbents	"	"	70%		"								$81/kW (1992) note 10	$482/ton SO2 (15 years) note 10
SOx-NOx-Rox-Box (SNRB) Flue Gas Cleanup	complete	hot baghouse with hi-temp bags, SCR catalyst, ammonia & sorbent injection	5 MWe equivalent	3.7% S	80-90%	90%	99.89%	HCl=95%; HF=84%			lo-grade agri. lime or cement			$13,271,620	$233/kW (1994) note11	
Gas Reburning and Sorbent Injection — T-Fired:	complete	GR-SI	71 MWe net	3.0% S	53% avg.	67% avg.	99.8%		approx. -1.0%					$37,588,955	$65/kW note 12	$300/ton SO2 note 12
Cyclone-fired:	"	"	33 MWe net	"	58% avg.	66% avg.	"		"						"	"
Milliken Clean Coal Technology	complete	formic-acid-enhanced wet limestone scrubber; lo-NOX concentric firing sys.; tile-lined split-module absorber; air preheater; PEOA control system	300 MWe	1.5-4.0% S	95-98%	0.39 #/MMBtu (note 20)	99.9%		approx. -1.0%		gypsum; lo-grade CaCl2	99.9% (FGD system)		$158,607,807	$300/kW (1998)	11.96 mills/kWh (current dollar basis)
Integrated Dry NOx/SO2 Emissions Control	completing	lo-NOX burners; in-duct sorbent injection; furnace urea injection	100 MWe	0.4% S	70%	80+%		Hg=80%; Trace Metals=nearly all				91%		$27,411,462		
ADVANCED ELECTRIC POWER GENERATION/FBC																
McIntosh Unit 4A PCFB	design	pressurized circulating fluidized bed combustor; hot gas part. filter system	137 MWe net	hi-ash, hi-S	95% (design)	0.3#/MMBtu (outlet design)	0.03#/MMBtu (outlet design)			36+% expected	potential solids			$186,588,000		
McIntosh Unit 4B Topped PCFB	pre-design	multi-annular swirl-burner topping combustor (addition to Unit 4A)	103 MWe net	"	"	"	"			40.6% expected; (45%commercial unit)	"			$219,635,546		
JEA Large Scale CFB Combustion	design	atmospheric circulating fluidized-bed combustor	265 MWe net		98% expected	0.09(NOx)#/MMBtu expected	0.017#/MMBtu expected			34.0%			4:1	$309,096,512		
Tidd PFBC	complete	pressurized fluidized bed combustor	70 MWe	2-4% S	90-95%	0.15-0.33#/MMBtu	0.02#/MMBtu	CO=0.01#/MMBtu		33.2% (40+% likely)				$189,886,339	$1263/kW (1997) note 13	
Nucla CFB	complete	atmospheric circulating fluidized-bed combustor	100 MWe net	0.5-1.5% S	95%	0.18#/MMBtu avg.	99.9+%	CO=70-140 ppmv		11,600 Btu/kWh	potential solids fill	97%	3:1	$46,512,678	$1,123/kW (actual)	64 mills/kWh (normalized)
ADVANCED ELECTRIC POWER GENERATION/IGCC																
Kentucky Pioneer	design	integrated gasification combined-cycle slagging fixed bed gasification sys.; molten carbonate fuel cell	400 MWe net (IGCC); 2.0 MWe (fuel cell)	Hi-S Bitumin.	<0.1#/MMBtu expected	<0.15#/MMBtu expected		CO2>20% reduction from conventional		40+%	slag, sulfur			$431,932,714		
Pinon Pine IGCC	startup	integrated gasification combined-cycle air-blown pressurized bed gasification	99 MWe net	0.5-0.9% (design)	0.069#/MMBtu	0.069#/MMBtu		CO2>20% reduction from conventional		43.7% expected				$335,913,000		
Tampa Electric IGCC	operating	integrated gasification combined-cycle pressurized oxygen-blown entrained-flow gasifier with acid gas cleanup	250 MWe net	2.5-3.5% S	<0.21#/MMBtu	<0.27#/MMBtu				40% expected	H2SO4; slag	>70% gasifier; >90% C.C.		$303,288,446		
Wabash River Coal Gasification Repowering	operating	integrated gasification combined-cycle 2-stage pressurized oxygen-blown entrained flow gasification system	262 MWe net	2.3-5.9% S	<0.1#/MMBtu expected	<0.1#/MMBtu expected	zero opacity	CO2~20% reduction from conventional		>38% (HHV)	sulfur	high		$438,200,000		
ADVANCED ELECTRIC POWER/COMBUSTION/HEAT ENGINES																
Healy Clean Coal	operating	entrained slagging combustor; spray dryer absorber w/ recycle	50 MWe nominal	35% Subbitum., 65%waste coal	90+%	<0.2#/MMBtu expected	5#/MMBtu NSPS	CO<0.2#/MMBtu est.	approx. 2% better	as expected at full load	none	56% demo year	2:1	$242,058,000	$5340/kW	40 mills/kWh
Clean Coal Diesel Demo	construction	coal-fueled diesel engine	6.4 MWe net	<0.2% S	50-70% below NSPS estimated	50-70% below NSPS estimated		CO2 est. 25% reduction from conventional		41.0%				$47,636,000	$1300/kW est.	
COAL PROCESSING FOR CLEAN FUELS																
Liquid-Phase Methanol (LPMEOH) Process	operating	methanol and dimethyl ether synthesis reactor	80,000 gallons MeOH/day	3-5% S							MeOH/DME (dimethyl ether)	>99%	7:1	$213,700,000	$29 million(note 19)	$0.465/gallon (note 19)
Self-Scrubbing Coal: Integrated Approach to Clean Air	on hold	physical coal-cleaning and fine mag-netite separation; sorbent addition	500 tph clean coal	1.8-3.9%	90% reduction pyritic S		removes most ash							$87,386,102		
Advanced Coal Conversion Process	operating	thermal coal conversion and physical cleaning to produce SynCoal	45 tph SynCoal	0.5-1.5% S	21% reduction from baseline (50:50 blend)		reduced ash			12,000 Btu/# SynCoal				$105,700,000		
Development of the Coal Quality Expert	complete	coal quality impact model software	250-880 MWe (6 diff. test sites)	wide variety blends										$21,746,004		
ENCOAL Mild Coal Gasification	complete	liquids-from-coal process	1,000 tpd feed coal	0.45%	solid fuel reduced to 0.36%S note 15	20% reduction from base burn		no listed toxins even close to limits		feed coal may go from 7,600 to 12,000 Btu/#	coal-derived liquic (note 15)	90%		$90,664,000	$475MM (2001) note 14	$52MM/year O&M costs (note 14)
INDUSTRIAL APPLICATIONS																
Blast Furnace Granular-Coal Injection System	completing	direct coal injection	7,000 net tons hot metal (NTHM) and 1,400 tons feed coal per furnace per day	0.4-2.8% S	note 16	note 16	note 16	note 16						$194,301,790		
Clean Power from Integrated Coal/Ore Reduction (CPICOR)	design	iron-making & electric coproduction	3,300 tpd liquid Fe; 170 MWe	0.5% S										$1,065,805,000		
Pulse Combustor Design Qualification Test	construction	steam reforming using multiple resonance tube pulse combustor	13 MMBtu/hr steam reformer	subbitum.										$8,612,054		
Advanced Cyclone Combustor with Internal S, N2 and Ash Control	complete	air-cooled slagging combustor	30 MMBtu/hr design; 19 MMBtu/hr operating	1.0-3.3% S	58% (combustor); >80% (furnace)	160 ppm (with scrubber)	72% avg. ash retention	slag essentially inert			slag		3:1	$984,394	$100-200/kW	
Cement Kiln Flue Gas Recovery Scrubber	complete	waste recovery scrubber	1,450 tpd cement; 250,000 scfm kiln gas; 274 tpd coal	2.5-3% S	94.6% end-run avg.	25% end-run avg.	0.005-0.007 gr/scf	HCl=98%(pilot test); VOC=76.6% avg.; CO2=2% reduction			cement kiln dust (CKD) feedstock; fertilizer	99.50%		$17,800,000	$10,090,000 (1990) note 17	$500,000/yr O&M (note 18)

NOTES:

1. Assumes three GSA units at 50% capacity, installed in a 300 MWe plant using 2.6% sulfur coal,over 15 year span.
2. Assumes 500 MWe unit burning 4%S in coal, at 50% SO2 capture.
3. Assumes two LIFAC reactors at 150 MW each ($76/kW for one @ 150 MW, and $99/kW for one @ 65 MW).
4. Assumes 75% SO2 removal with a Ca/S molar ratio of 2.0, using 95% CaCO3 at $15/ton limestone.
5. Assumes 500MWe unit burning 4.5% S in coal, at 90% SO2 removal efficiency.
6. Assumes 605 MWe unit over 30 years.
7. Assumes 300 MWe unit.
8. Assumes 250 MWe unit with 0.35# inlet NOx/MMBtu.
9. Assumes 500 MWe unit burning 3.2% S coal, using a constant $ basis.
10. Assumes 500 MWe unit burning 3.5% S coal.
11. Assumes 250 MWe unit burning 3.5% S coal, with initial NOx inlet of 1.2 #/MMBtu.
12. Assumes 100 MWe unit at 60% NOx reduction, with 15% gas heat input. Does not include gas pipeline installation. $300/ton SO2 is for Sorbent Injection (SI) only.
13. Based on similar technology of a 360 MWe unit in Japan.
14. Assumes 15,000 metric tpd feed coal.
15. Liquid fuel contains 0.6% S at 140,000 Btu/gal, compared to No.6 oil with 0.8% S and 150,000 Btu/gal.
16. There is a net decrease in pollutant emissions since coke production is replaced with direct coal injection.
17. Assumes a flue gas recovery system for a 450,000 tpy wet processing plant.
18. This is generally offset by fuel savings, feedstock recycling and waste elimination, and fertilizer revenues.